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LYCOPODIACEAE SPORES FROM LOWER CRETACEOUS DEPOSITS OF HUNGARY

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Abstract

The paper describes 21 species of Lycopodiaceae family from the Lower Cretaceous deposits of Transdanubian Central Mountains in Hungary. These 21 formspecies are recognised as belonging to five formgenera. They are following: *Retitriletes*, *Vadaszisporites*, *Foveosporites*, *Sestrosporites*, and *Camarozonosporites*. Four new combinations are proposed and two of the species described are new. The stratigraphic distribution of the Lycopodiaceae spores: most of the species of *Retitriletes*, *Sestrosporites* and *Foveosporites* described from the Neocomian, Aptian and Lower Albian strata. The younger sediments (Upper Albian—Lower Cenomanian) are characterized by the formspecies of *Vadaszisporites* and *Camarozonosporites*.

Introduction

On Hungarian territory the Lower Cretaceous deposits can be found in the Transdanubian Central Mts and Villány Mts. Several works are dealing with the stratigraphic evaluation of these layers from which we emphasize Fülöp's papers (1958, 1964, 1966) as comprehensive works. The stratigraphic investigations are carried on in our days, as well.

In the course of the palynological investigation of the Transdanubian Lower Cretaceous deposits the comparatively uniform character of the flora of that period is conspicuous. The floras are characterized by the fossil representatives of Pteridophyte. About 60 per cent of the spores found are fern-spores, while the spores of the Lycopsida and Sphenopsida classes are present only in a lower number.

In our present paper, we are dealing, within the Lycopsida class, with the spores of some taxons of Lycopodiaceae family from the Lower Cretaceous.

Previous Works

The histological, taxonomic, phytogeographical elaboration of the living Lycopodiaceae can be found in several monographs, textbooks, papers. The works of PRITZEL (in ENGLER—PRANTL, 1902), NESSEL (1939), KNOX (1950) and HARRIS (1955), reporting on about 420 to 450 Lycopodiaceae species, distinguish themselves even among these. These are included by a part of authors in two genera: *Lycopodium* L. and *Phylloglossum* KUNZE. Others, like HERTER (1909), emphasize subgenus *Urostachys* of genus *Lycopodium* and -classing 340 species or so therein — are

raising it to a rank of genus. NESSEL (1939) was already applying the following three genera: *Lycopodium* (L.) HERTER, *Phylloglossum* KUNZE, *Urostachys* (PRITZEL) HERTER. Our knowledge of the spores of the recent Lycopodiaceae is rather defective. The spores of about 25 per cent of the species described have been elaborated anyhow. Illustrations of spores are published by a number of authors, but the morphological grouping of spores is treated of first by KNOX (1950). He created five groups: three foveolate, one reticulate groups, and an echinate one. HARRIS (1955) revised Knox's work and the "Group Clavatum" is subdivided into two: a rugulate (hamulate) and a reticulate group. The classification of the recent Lycopodiaceae spores, that is best even today, is to be found in KRUTZSCH's publication (1963). He created four morphological groups, with twelwe morphotypes. These are the following:

1) foveolate spore-forms. Morphotypes: "selago", "phlegmaria", and "verticillatum".
2) reticulate spore-forms. Morphotypes: "paniculatum", "ramulosum", "sprucei", "annotinum", and "clavatum".
3) hamulate spore-forms. Morphotypes: "cernuum", "carolinianum", and "inundatum".
4) verrucate-echinate spore-form. Morphotype: "densum".

A great merit of KRUTZSCH's work is that it is comparing the recent morphotypes with the formgenera of the fossil dispersed spores. The author is proving that Retitriletes formgenus is a level corresponding to the "Clavatum" group, the *Camarozonosporites* to the "hamulate" spore-forms, and the Selagosporis to the "selago"-morphotype; therefore, the levels of recent and fossil organtaxons do not conform entirely to each other. But that doesn't exclude a relationship of Tertiary spore-forms, included in the above formgenera and in those described by him, to the recent Lycopodiaceae species. However similar some spore-forms may be to the recent ones, the Mesozoic palynological literature is treating the problem of botanical relationship very carefully. Some reference to the Lycopodiaceae-origin is only found at the most known forms of *Lycopodiumsporites austroclavatidites, clavatoides* . There are, anyway, several factors that incite us to try to recognize some relationship between the Lycopodiaceae species living today and the motherplant of the "lycopodiaceous" spores investigated by us. The main characteristics from among these are the following:

1) Phylogenetic connection
   All the recent Lycopodiaceae species have herbaceous stems. Among the fossil forms is the genus Lycopodites, which resemble in general form those of the extant Lycopodium. Lycopodites have been found from the Carboniferous to the present.
2) Anatomically the fossil *Lycopodites* are very similar to the living Lycopodiaceae; both genera have herbaceous, dichotomously branched stems, exarch protostele, microphyllous leaves, adaxial sporangia, and homosporous condition.

3) Geographical distribution
   Those still living are world-wide in distribution, but most species are found in the tropics.
   As PRITZEL (in ENGLER—PRANTL, 1902) is writing, their distribution has two focuses:

a) The Palaeotropic species were starting from South India, East-Himalaya towards Africa, Australia Polynesia, New-Zealand;

b) The Neotropic species diffused from the Brasilian and Columbian area of the Andes to other regions on the territory of South and Central America.

The Aptian—Albian stage of the Lower Cretaceous in the area of the European Flora Province is characterized by the breaking forth of the humid, subtropical-tropical climate, that may have facilitated the appearance of the Lycopodiaceae so rich in species.

4) Ecologic claim

The majority of recent Lycopodiaceae claim an equalized, humid atmosphere, they don't require too much heat and light. They are therefore the richest in species in mountains, in woods of not too thick vegetation, on islands and in places of oceanic climate. They generally prefer a substratum rich in organic matter (PRITZEL, in ENGLER PRANTL, 1902).

5) Their role in producing formations

It is equally characteristic both of the recent and Mesozoic Lycopodiaceae that they are not exerting any considerable influence on the picture of the formation.

6) The sculpture of spores

The spore-forms of sculpture-element, that is the reticulate, foveolate, verrucate-echinate ones, outlined by KRUTZSCH (1963) as a characteristic of recent Lycopodiaceae-spores, are frequent in case of the spores in the Lower Cretaceous.

On the basis of above literary data we have come to the conclusion that—supposing the botanical connection — we should treat of the spores of reticulate, foveolate, hamulate structures, found in our material, like of the fossil representatives of Lycopodiaceae. The recent spores of verrucate-echinate type are less frequent and less known; the Selaginellaceae-spores are of similar structure, as well. We do not deal, therefore, with the fossil spores of a structure, like this, in our present paper.

Materials and Methods

The procedure of samples took place with Zólyomi—Kedves's method. The preparations were preserved in glycerin-jelly.
Determinations and countings are made with a Zeiss NfpK microscope.
Holotypes and figured specimens are lodged in the palynology collection of the Department of Botany, Attila József University, Szeged.

Systematic description

Phylum	**PTERIDOPHYTA**
Class	**Lycopsida**
Order	**Lycopodiales**
Family	*Lycopodiaceae*

Genus *RETITRILETES* (PIERCE, 1961) DÖRING, KRUTZSCH, MAI et SCHULZ, 1963 (short: D. K. M. S. 1963)

Syn.: *Lycopodiumsporites* THIERG. ex DELCOURT et SPRUMONT 1955.

Type species: *Retitriletes globosus* PIERCE, 1961.

Remarks: Some authors have included in the formgenera *Retitriletes* and *Lycopodiumsporites* the spores of Lycopodiaceae-affinity whose distal surface is reticulate and proximal surface is mostly smooth (non-reticulate). In the English palynologic literature the name *Lycopodiumsporites* is used almost exclusively, not accepting the opinion of DÖRING et al. (in KRUTZSCH, 1963, p. 11.) summarized as follows:

1) KRUTZSCH proved by re-examining Thiergardt's original slide (1963, Table 40, figs. 2—4) that the Niederlausitz-form of *Lycopodiumsporites agathoecus* (R. POT.) THIERG. 1938, considered as the type species of genus, is a recent *Lycopodium clavatum* L.

2) The Eocene form *Sporites agathoecus* (from Geiseltal), described by R. POTONIE in 1934, is not reticulate but of macrofoveate sculpture, and a form of Shizaeaceae affinity, being close to Foveasporis.

3) *R. Potonie,* in his SYNOPSIS (1956), gives "agathoecus" as the type-species of *Lycopodiumsporites* but his diagnosis and schematized diagram are approaching Thiergardt's form, corresponding to a recent species.

In that way, the genus hasn't type-species, whoever may be considered as an author.

Concerning *Retitriletes* it is to be noticed that PIERCE (1961) does not refer to the genus-name being taken over from van der HAMMEN.

By the emended diagnosis of DÖRING et al. (in KRUTZSCH, 1963), a form-genus, selected by them more or less arbitrarily and characterized but poorly, is made valid.

Retitriletes tenuis (BALME, 1957) n. comb.
Plate 1, Figs. 1, 2.

1957 *Lycopodiumsporites austroclavatidites tenuis* n. sp. BALME, p. 16., Pl. 1, Figs. 9—11.

1968 *Lycopodiumsporites tenuis* (BALME) n. comb. NORRIS, p. 319., Figs. 37—38.

Remarks: NORRIS (1968) was separating *Lycopodiumsporites tenuis* BALME from *Lycopodiumsporites austroclavatidites* as an independent form-species. The former species is generally of smaller size than 30 μ, the lumina of reticulum narrower, muri low, the trilete mark is less prominent.

Occurrence. Hungary: Gerecse Mts (Neocomian), Bakony Mts (Aptian—Lower Albian). Rare.

Plate 1. 1,2 *Retitriletes tenuis* (BALME, 1957) n. comb, Gerecse Mts, Borehole Süttő—3:125/3. P:32./102,9

3,4 *Retitriletes austroclavatides* (COOKSON, 1953) D. K. M. S. 1963, Bakony Mts, Tés, Borehole Té—27:46,0 /1.P:30,5./92,9

5,6 *Retitriletes clavatoides* (COUPER, 1958) D. K. M. S. 1963 Gerecse, Mts, Süttő—3:111/1 P:44,4) 100,3

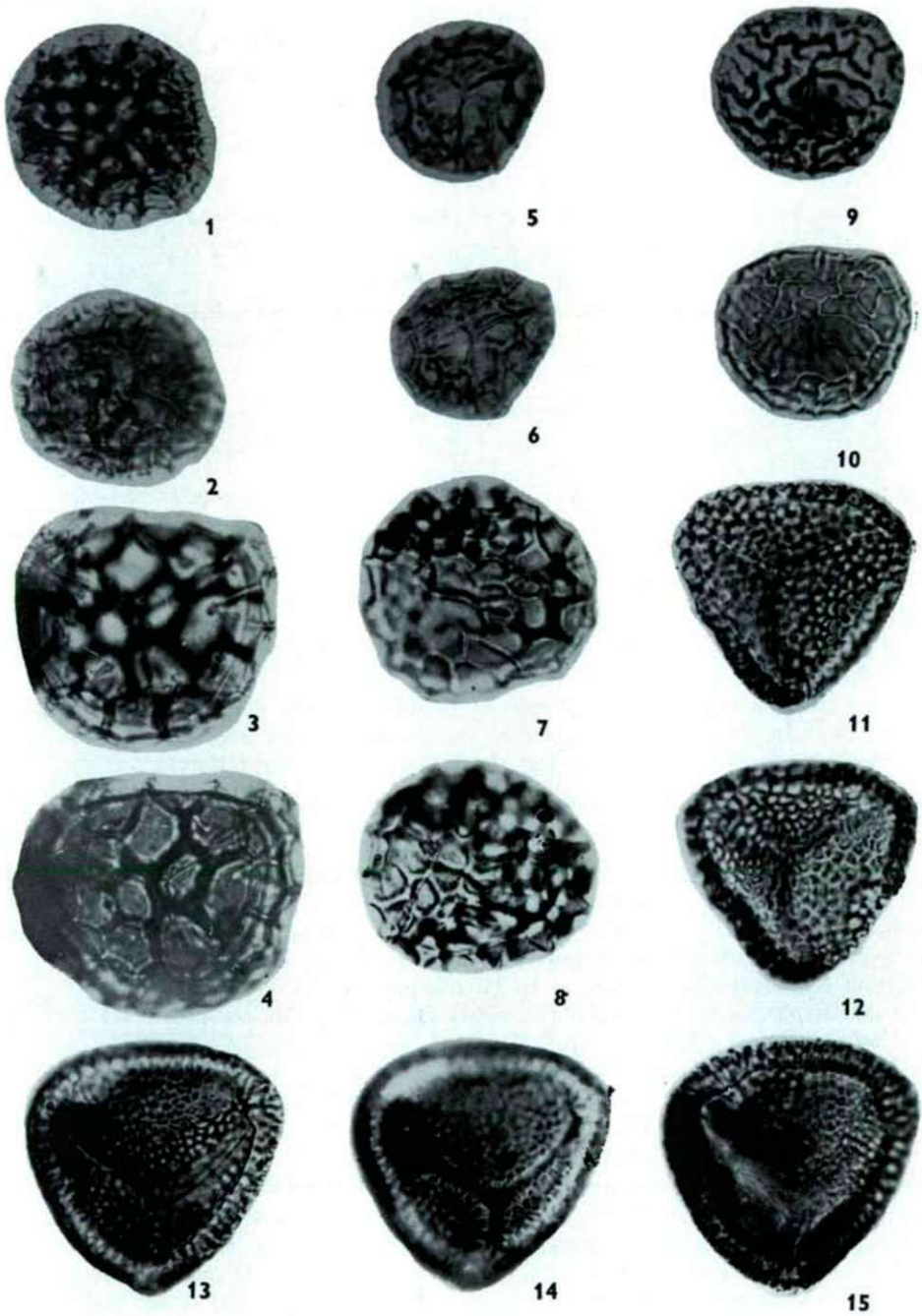
7,8 *Retitriletes dentimuratus* (BRENNER, 1963) n. comb, Bakony Mts, Hárskút, Borehole Hk—4:247 /1.P:40,2./107

9,10 *Retitriletes glebulentus* (KEMP, 1971) n. comb, Tatabánya Basin, Borehole Ta—1366:160 /1.P:36,2./97

11,12 *Vadaszisporites urkuticus* (DEÁK, 1964) DEÁK et COMBAZ 1967, Bakony Mts, Borehole Pe—27:82,7m /2.P:32./113,1

13,15 *Vadaszisporites urkuticus* (DEÁK, 1964) DEÁK et COMBAZ, 1967, Bakony Mts, Balinka. Borehole Ba—237:48 /4.P:46,6/ 112,1

Plate 1



Retitriletes austroclavatidites (COOKSON, 1953) D. K. M. S. 1963
Plate 1., Figs. 3, 4.

1953 *Lycopodium austroclavatidites* n. sp. COOKSON, p. 469, Pl.2, Fig. 35.
1963 *Retitriletes austroclavatidites* (COOKSON) n. c. DÖRING, KRUTZSCH, MAI, SCHULZ, p. 16.

Remarks: DETTMANN (1963) is giving a good description and synonim-list of this species.

Occurrence. Hungary: Gerecse Mts (Neocomian), Bakony and Vértes Mts (Aptian—Lower Albian)

Retitriletes clavatoides (COUPER, 1958) D. K. M. S. 1963
Plate 1., Figs. 5, 6.

1958 *Lycopodiumsporites clavatoides* n. sp. COUPER, p. 132, P 1.15., Figs. 10, 11.
1963 *Retitriletes clavatoides* (COUPER 1958) n. comb. DÖRING, KRUTZSCH, MAI et SCHULZ, p. 16.

Occurrence. Hungary: Gerecse Mts (Neocomian)

Retitriletes dentimuratus (BRENNER, 1963) n. comb.
Plate 1., Figs. 7, 8.

1963 *Lycopodiumsporites dentimuratus* n. sp. BRENNER, p. 44. P 1.5, Fig. 4.

Remarks: It is a form occurring comparatively rarely. The specimens in Hungary are generally somewhat smaller than the holotype.

Occurrence. USA: Maryland (Potomac group); Hungary: Bakony Mts (Upper Albian).

Retitriletes glebulentus (KEMP, 1971) n. comb.
Pl. 1., Figs. 9, 10.

1971 *Lycopodiumsporites glebulentus* n. sp. KEMP, p. 88—89, Pl. 12, Figs. 1—6.

Remarks: In the specimens examined by us, the circular area on the distal pole is anyway to be found but it is less thickened than in the holotype.

Occurrence. South England: Atherfield (Lower Albian); Hungary: Tatabánya Basin, Gerecse Mts (Lower Albian).

Genus *VADASZISPORITES* (DEÁK et COMBAZ, 1967) emend.

Emended diagnosis: azonotrilete miospores. Amb rounded to subtriangular, with convex or straight sides. Exosporium ornamented both proximally and distally with positive microreticulate-reticulate pattern. Lumina of reticulum somewhat polygonal in outline. The species to be included in the genus are:

1) *Vadaszisporites urkuticus* (DEÁK, 1964) DEÁK et COMBAZ, 1967
2) *Vadaszisporites gregussi* n. fsp.
3) *Vadaszisporites minutireticulatus* n. fsp.
4) *Vadaszisporites pseudofoveolatus* (DEÁK, 1964) DEÁK et COMBAZ, 1967
5) *Vadaszisporites sacali* DEÁK et COMBAZ, 1967
6) *Vadaszisporites* (al. *Microreticulatisporites*) *uniformis* (SINGH, 1964) n. comb.

Remarks: The genus created by DEÁK et COMBAZ (1967) is collecting the microreticulate-reticulate forms on both surfaces whose reticulum is positive, separated from the genus *Microreticulatisporites* (KNOX, 1950) R. POT. et KR. 1954, of "negative" reticulum (cf. KRUTZSCH, 1963, p. 11, 14, Fig. 9), and from *Retitriletes* (al. *Lycopodiumsporites*) having a positive reticulum but on the distal surface.

The authors of *Vadaszisporites,* in their genusdiagnosis, wrote about a "reticulate cingulum". But after examining a number of specimens it was proved that at these forms there is no cingulum only the wall of exosporium may be very thick.

The wall-thickness varies at the single species and even the different specimens of the same species may differ from one another in wall-thickness.

DEÁK (1964) was describing *Vadaszisporites urkuticus* and. *V. pseudofoveolatus* from the "Munieria marl" sediments in Bakony Mts, GÓCZÁN (in NAGY, 1971) and SCHOLZ (1974) placing these layers in the Albian.

Vadaszisporites urkuticus (DEÁK, 1964) DEÁK et COMBAZ, 1967.
Pl. 1., Figs. 11—15.

1964 *Microreticulatisporites urkuticus* n. sp. DEÁK, p. 106, Pl. 2, 14—15.
1967 *Vadaszisporites urkuticus* (DEÁK, 1964) n. comb. DEÁK et COMBAZ, p. 79, Pl. 1, Fig. 13.

Remarks: According our investigations, it appeared first at the upper level of dark-grey aleurolit of the Gerecse Mts and Tatabánya Basin (Lower Albian). GÓCZÁN (1964) found it at Upper-Maestricht substage, as well, and evaluated it there as a stratigraphically important formation.

The wall-thickness is, within the species, a very varying feature. In case of Upper Albian specimens the percentage of those having thicker exosporium is higher.

Occurrence. Hungary: Gerecse Mts, Tatabánya Basin (Lower Albian), Bakony, Vértes Mts (Upper Albian). In France: Saintogne (Upper Albian—L. Cenomanian).

Vadaszisporites sacali DEÁK et COMBAZ, 1967
Pl. 2., Figs. 1, 2.

1967 *Vadaszisporites sacali* n. sp. DEÁK et COMBAZ, p. 79, Fig. 14.

Remarks: This form is one of the characteristic formspecies of Upper Albian and Lower Cenomanian of Bakony Mts.

Exosporium of spore is usually profusely reticulate, with a thick wall. The lumina of microreticulum are narrow, pentagonal-or hexagonal.

Occurrence. Hungary: Bakony Mts (Upper Albian—Lower Cenomanian). France: Saintogne, Landun (Upper Albian—Cenomanian).

Vadaszisporites gregussi n. fsp.
Pl. 2., Figs. 3, 4.

Derivatio nominis: The specific epithet is given after Prof. P. Greguss, A. József University, Szeged.

Holotypus: Slide Pe—31: 351/2. P: 30,0/98,0 Pl. 2, 3, 4.

Locus typicus: Borehole Pe—31, Olaszfalu (Bakony Mts).

Stratum typicum: Turrilites marl (Upper Albian)

Diagnosis: Trilete miospore; amb subcircular to subtriangular, with convex sides, and rounded apices. Laesura straight, simple, lenght about 4/5 spore radius. Exosporium 3—4 μ thick. Both proximal and distal surfaces ornamented with regular, polygonal, positive reticulum. Lumina of reticulum 4—5 μ across, muri 0,5—1 μ wide and 1—1,5 μ wide at their bases; height 1—1,2 μ.

Size range: 48—54 μ.

Comparison: This species differs from the other Vadaszisporites species by its convex sides, larger lumina of reticulum and thicker muri.

Occurrence. Hungary: Bakony Mts (Upper Albian).

Vadaszisporites uniformis (SINGH, 1964) n. comb.
Pl. 2., Figs. 5, 6.

1964 *Microreticulatisporites uniformis* n. sp. Singh, Pl. 103, Figs. 15, 16.
1971 *Microreticulatisporites uniformis* SINGH 1964 PLAYFORD, p. 539, Pl. 103, Figs. 15, 16.

Remarks: We have thought good to transfer the form of positive reticulum described by SINGH (1964) to the genus *Vadaszisporites*, on the basis of the figure published and the present form being similar.

Occurrence. Hungary: Bakony Mts (Upper Albian); Canada Alberta (Albian).

Vadaszisporites minutireticulatus n. fsp.
Pl. 2., Figs. 7, 8.

Derivatio nominis: after its very fine microreticulate sculpture.

Holotypus: Slide Pe—27:82, 6—86,7 m /3. P: 35.7/ 108.7

Locus typicus: Borehole Pe—27. Olaszfalú, Bakony Mts
Stratum typicum: Turrilites marl (Upper Albian).

Diagnosis: Trilete miospore; amb subcircular to convexly subtriangular, with rounded angles.

Laesure straight, short, extending to 1/2 of spore radius. On the proximal and distal surfaces a very fine, positive microreticulate sculpture is to be observed. Lumina of microreticulum 0,3—0,5 μ across. Muri alway thinner than lumen in diameter. Exosporium 1—1,5 μ thick.

Size: 40—48 μ.

Comparison: This species differs from *Vadaszisporites uniformis* and *Vadaszisporites pseudofoveolatus* in its larger size, mostly rounded amb, and very fine microreticulate sculpture.

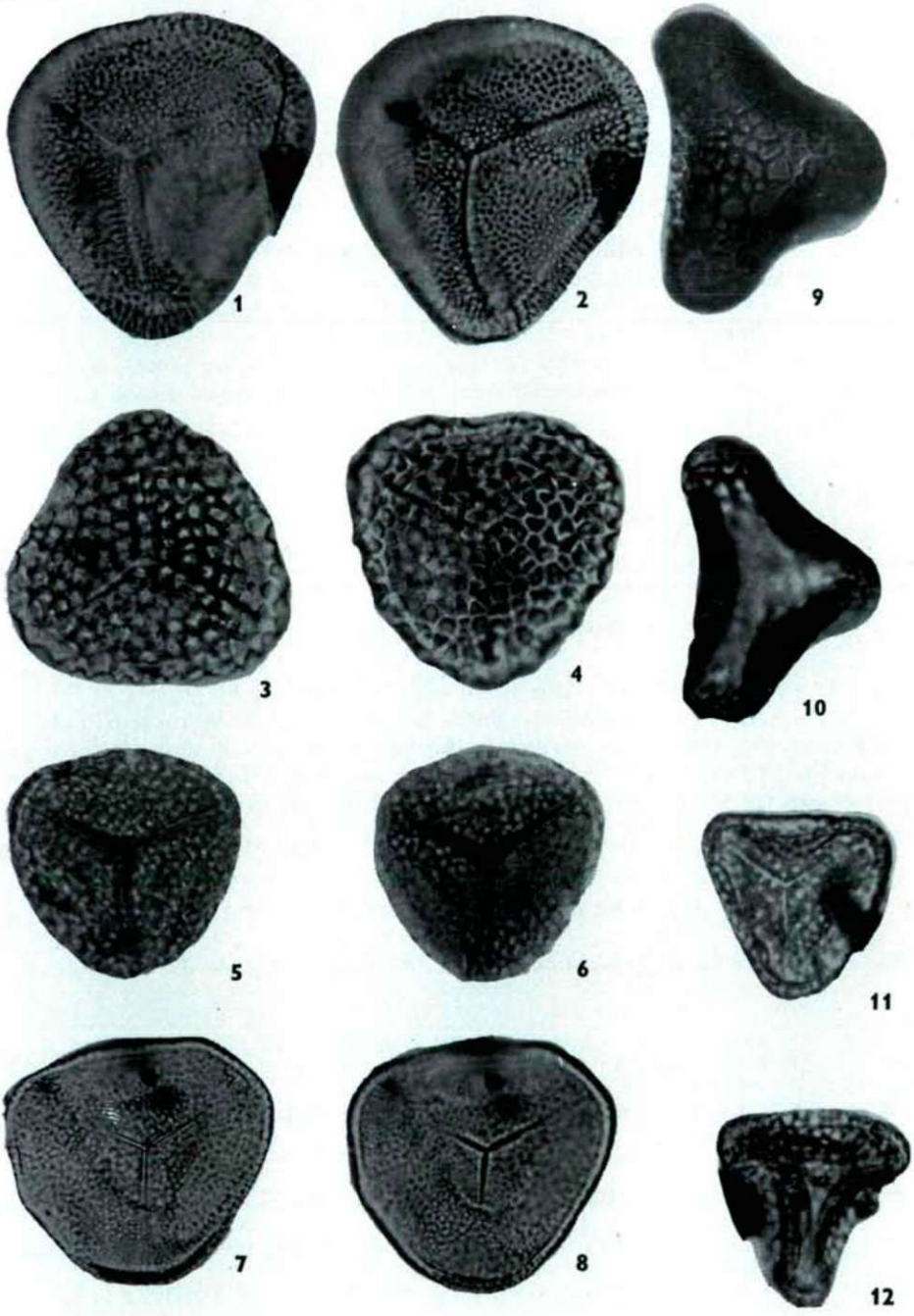
Occurrence. Hungary: Bakony Mts (Upper Albian—Lower Cenomanian). Occasional.

Vadaszisporites fsp.
Pl. 2., Figs. 9, 10.

Occurrence. Rare form from Turrilites marl of Bakony.

Plate 2. 1,2 *Vadaszisporites sacali* DEÁK et COMBAZ, 1967 Bakony Mts, Olaszfalu. Pe—31: 161/1.P:30,5./105,3
3,4 *Vadaszisporites gregussi* n. fsp. Bakony Mts, Olaszfalu. Pe—31:351 /2.P:30,0./98,0
5,6 *Vadaszisporites uniformis* (SINGH, 1964) n. comb. Bakony Mts, Olaszfalu. Pe—31: 333/2.P:39,5./108,7
7,8 *Vadaszisporites minutireticulatus* n.fsp. Bakony Mts, Olaszfalu. Pe—27:82,7 m/3. P:35,7./108,7
9,10 *Vadaszisporites* sp. Bakony Mts, Hárskút. Hk—4:10 /3.P:35,2./96,7
11,12 *Vadaszisporites pseudofoveolatus* (DEÁK, 1964) DEÁK et COMBAZ, 1967 Bakony Mts, Csehbánya. Cs—5:265 m /1.P:45,5./93,6

Plate 2



Vadaszisporites pseudofoveolatus (DEÁK, 1964) DEÁK et COMBAZ, 1967
Pl. 2., Figs. 11, 12.

1964 *Microreticulatisporites pseudofoveolatus* n. sp. DEÁK, p. 106—107, Pl. 2, Figs 16—18.

1967 *Vadaszisporites pseudofoveolatus* (DEÁK, 1964) n. comb. DEÁK et COMBAZ, p. 79.

Remarks: *V. pseudofoveolatus* is of the smallest size among the *Vadaszisporites* species. Most specimens have a kyrtom-like labra (Fig. 12), although the exosporium is thick enough (2—2,5 μ). It manifests itself already in the Lower Albian deposits.

Genus *FOVEOSPORITES* BALME 1957

Type species: *Foveosporites canalis* BALME 1957

Remarks: This genus was constructed by BALME (1957) for rounded to rounded-triangular spores of foveolate sculpture. *Foveotriletes* van der HAMMEN and *Microreticulatisporites* (KNOX) R. POT. et KR. distinct from *Foveosporites* BALME. The first genus having a concavely triangular amb, the latter genus having a reticulate sculpture.

Foveosporites canalis BALME 1957
Pl. 3., Figs. 1, 2.

1957 *Foveosporites canalis* n. sp. BALME, Pl. I., Figs. 15—17.

Occurrence. It is a frequent form in the Aptian to Albian deposits of the Tatabánya Basin and Gerecse Mts from among the Lower Cretaceous deposits in Hungary. It occurs but rarely together with the Vadaszisporites species.

Foveosporites subtriangularis (BRENNER, 1963) SCHULZ, 1966
Pl. 3., Figs. 3, 4.

1963 *Foveotriletes subtriangularis* n. sp. BRENNER, p. 62., Pl. 16, Fig. 2.

1966 *Foveosporites subtriangularis* (BRENNER 1963) n. comb. SCHULZ, p. 134.

Remarks: The foveae of form published by us are of somewhat narrower lumina than those of holotype. The arrangement of this form among the *Foveosporites* was carried out by KEMP (1971) and PHILLIPS et FELIX (1971), as well.

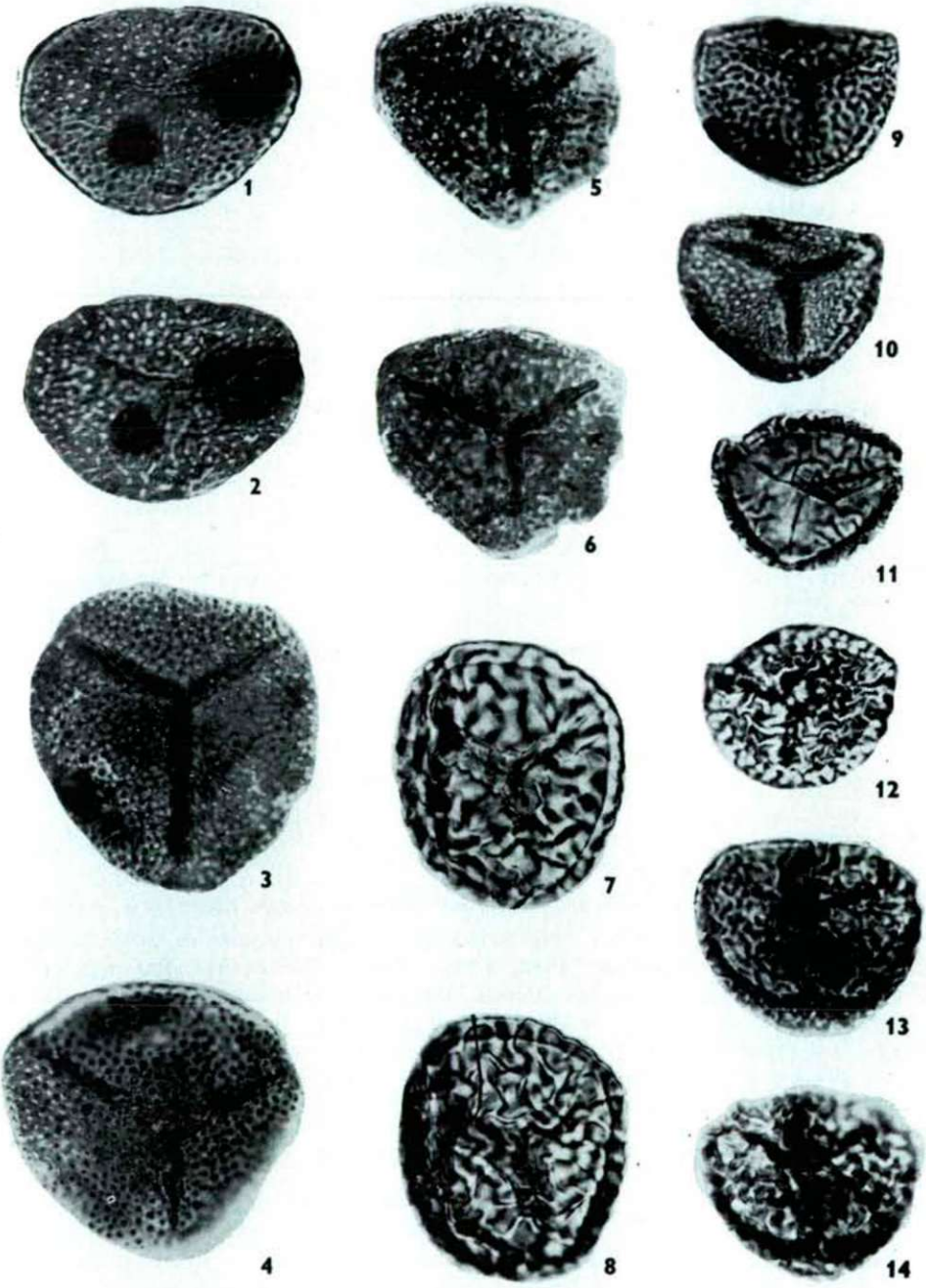
Occurrence. Hungary: Tatabánya Basin (Lower Albian). USA: Maryland (Potomac Group). England: Redcliff (Upper Aptian).

Foveosporites multifoveolatus DÖRING, 1965
Pl. 3., Figs. 5, 6.

1965 *Foveosporites multifoveolatus* n. fsp. DÖRING, p. 43—44, Pl. 15, Figs. 3—5.

Plate 3. 1,2 *Foveosporites canalis* BALME1957 Gerecse Mts, Süttő—3:13 /3.P:38,9./101,8
3,4 *Foveosporites subtriangularis* (BRENNER, 1963) SCHULZ, 1966 Tatabánya Basin. Ta—1358:369,5 m /2. P:44,6./101,5
5,6 *Foveosporites multifoveolatus* DÖRING, 1965 Tatabánya Basin. Ta—1329:461,5 m/2. P:42,2./111,1
7,8 *Camarozonosporites insignis* NORRIS, 1967 Bakony Mts, Csehbánya. Cs—5:273 m/1. P:30,5./108,9
9,10 *Sestrosporites pseudoalveolatus* (COUPER, 1958) DETTMANN, 1963 Tatabánya Basin. Környe. Kö—24:245 /1. P:42,0./101,0
11,12 *Camarozonosporites cerniidites* (ROSS, 1949) W. KR. 1959 Bakony Mts. Hárskút. Hk—4:641 /2. P:38,7./111,9
13,14 *Camarozonosporites* sp. Gerecse Mts, Süttő—3:119 /1. P:43,4./107,1

Plate 3



Occurrence. Döring (1965) described it from Westmecklenburg, from the uppermost stage of the layers Wealden. In Hungary, it is frequent in the Neocomian deposits of Gerecse Mts and occurs in the Aptian, as well. RÁKOSI (1971) described it from the Neocomian deposits of Dorog Basin.

Genus *SESTROSPORITES* DETTMANN 1963

Type species: *Sestrosporites irregulatus* (COUPER, 1958) DETTMANN, 1963.

This genus was applied by DETTMANN (1963) to the proximally smooth, distally foveolate-foveoreticulate trilete spore-forms whose exosporium in the interradial regions became thicker.

Sestrosporites pseudoalveolatus (COUPER, 1958) DETTMANN, 1963

Pl. 3., Figs. 9, 10.

1958 *Cingulatisporites pseudoalveolatus* n. sp. Couper, p. 147, Pl. 25., Figs. 5, 6.
1963 *Sestrosporites pseudoalveolatus* (COUPER) n. comb. DETTMANN, p. 66, Pl. 13, Figs. 11—16.

Remarks: This form was found by COUPER (1958), GUY (1971) in the Jurassic deposits, by DETTMANN (1963), SINGH (1964), NORRIS (1967), KEMP (1971), ČORNA (1970, 1972) in the Aptian and Albian deposits.

In Hungary it was found in the Lower Albian deposits of Tatabánya and Gerecse Mts.

Genus CAMAROZONOSPORITES (PANT ex R. POT., 1956) KLAUS, 1960

Type species: *Camarozonosporites cretaceus* (WEYLAND et KRIEGER, 1953) R. POT. 1956.

Camarozonosporites insignis NORRIS, 1967

Pl. 3., Figs. 7, 8.

1967 *Camarozonosporites insignis* n. sp. NORRIS, p. 96, Pl. 13, Figs. 14—16.

Occurrence. Hungary: Bakony Mts (Middle Albian). USA: Maryland (Albian—Cenomanian). Canada: Alberta (Albian—Cenomanian). England: Warlingham (Aptian—Albian).

Camarozonosporites cerniidites (ROSS, 1949) W. KR. 1959

Pl. 3., Figs. 11, 12.

1949 *Lycopodium cerniidites* n. spm. ROSS, p. 30—31, Pl. 1, Figs. 1—2.
1959b *Camarozonosporites cerniidites* (ROSS, 1949) n. comb. KRUTZSCH, p. 187.

Remarks: *C. cerniidites* were placed by various authors in different form-genera. COUPER (1958) ranged them among *Lycopodiumsporites*, BRENNER (1963) among *Lycopodiacidites*. In our opinion, owing to the hamulate sculpture of the distal surface of the form, it is absolutely justified if we put in *Camarozonosporites* genus. It is placed by KRUTZSCH (1963, p. 22) even at subgenus level in the *Camarozonosporites* (*Camarozonosporitess*) subgenus that contains only those having hamulate forms on their distal surface.

Occurrence. Hungary: Bakony Mts (Upper Albian—Cenomanian).

Camarozonosporites sp.

Pl. 3., Figs. 13, 14.

Remarks: The form published is somewhat similar to the form *Lycopodiacidites arcuatus* HEDLUND 1966 its distal surface is, however, of hamulate sculpture

where the sculpture-elements are showing, in some places, a "corrugate" form. The proximal surface is smooth, divided into three areas. The sides of spore became thick interradially.

Occurrence. Hungary: Gerecse Mts (Lower Albian)

Conclusion

In the sporomorpha-associations of the Lower Cretaceous deposits in Hungary, the spores of Lycopodiaceae-affinity, emphasized by us and published above, don't play any significant part. It may be supposed that in that Period Lycopodiaceae family, even if it had the due species number, did not form any association.

In the Neocomian and Aptian deposits *Retitriletes austroclavatidites, Retitriletes clavatoides, Foveosporites canalis, Foveosporites multifoveolatus* can be found. As these forms are distributed enough in time and space (some species being present in the Jurassic deposits) as well, and in the Lower Cretaceous age having a wide geographical distribution, it is to be supposed that the mother-plants of these spores accomodated themselves well to the ecologic and climatic conditions, were species of cosmopolitan character.

The great majority of the formspecies *Vadaszisporites* appeared in the Middle and Upper Albian. The ecologic claim of these Lycopodiaceae species may already have been connected with the warm, more humid, subtropical-tropical climate, possibly with the gallery-forestlike open plant associations.

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